1846SX/P

SECTION 5. TROUBLESHOOTING AND MAINTENANCE

5.1 INTRODUCTION

This section of the manual contains procedures for entering Calibration Modes 1, 2, 3, and 4 and for using these calibration modes to perform various checks of the Monitor. These checks should be made periodically to make particular adjustments to the circuits on the CPU board and the 1846 SX/P Printer Control Board and to locate malfunctions at a module level and to replace that defective module.

5.1.1 Using Calibration Modes 1, 2, 3, and 4

The Model 1846 SX series software provides four calibration modes to perform certain analog circuit, power supply voltage, and display LED checks.

To enter calibration mode (Calibrations Modes 1, 2, 3, and 4), press the (CYCLE) SET switch *while turning power on* to the Monitor. The first mode you enter is Calibration Mode 1. Then, each time you press the (CYCLE) SET switch, the calibration mode increments until Calibration Mode 4. At that point, when you press (CYCLE) SET, the sequence repeats, i.e., Calibration Mode 1, 2, 3, and then 4.

To enter calibration mode for an *indefinite* period of time, hold the (CYCLE) SET switch for at least 20 seconds *after* you turn on power. If you do not place the Monitor in the calibration mode for an indefinite period, the program will exit any one of the four calibration modes at the end of approximately three minutes, an alarm will be activated and the Monitor will enter manual mode just as in normal power on. A three minute timer resets whenever you switch to a new calibration mode.

To exit calibration mode (1, 2, 3, or 4), press AUTO MANUAL, CANCEL, START, or STAT MODE switches.

5.1.1.1 CALIBRATION MODE 1 To repeat, Calibration Mode 1 is the first mode entered. In Calibration Mode 1,

- ☐ flashing 88s display in the CYCLE MINUTES window;
- ☐ the CUFF indicator lights;
- ☐ the microprocessor performs an auto-zero;
- ☐ the MAP display should show the pressure in mmHg applied to the pressure transducer; and
- ☐ all other displays should be blanked.

5.1.1
Using Calibration Modes 1, 2, 3, and 4

The appearance of the front panel should be as shown in Figure 5-1.

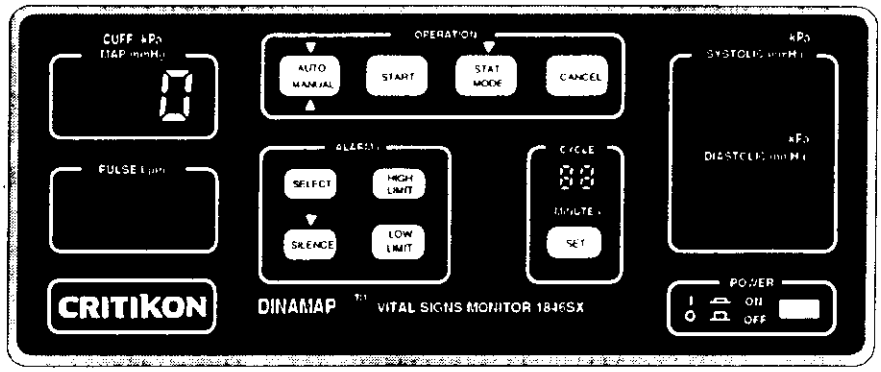

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Figure 5-1. Calibration Mode 1 Display

In this mode; the Auto Zero Valve, Step Deflate Valve, and Dump Valve remain closed and the microprocessor reads and displays the pressure applied to the RETURN port on the rear of the Monitor.

5.1.1.2 **CALIBRATION MODE 2** Calibration Mode 2 is entered from Calibration Mode 1 by momentarily pressing the (CYCLE) SET switch. In Calibration Mode 2,

- the CUFF indicator remains lighted;
- flashing 88s display in the CYCLE MINUTES window;
- the MAP display continues to show the pressure at the RETURN port on the rear of the unit; and
- the PULSE display will show the binary count applied to the D-to-A converter providing the dc offset voltage calculated during the auto zero when Calibration Mode 1 was entered. The binary count may be any value between 0 and 255, representative of a dc offset voltage between 0 and +2.55 Vdc.
- The SYSTOLIC display will show the output of the Filtered Pressure Transducer Amplifier (set for adult gain) in terms of A/D units (20 mV per A/D unit). At zero pressure into the RETURN port, this value should be a steady 9 to 11 A/D units. The gain of the amplifier can be switched to neonate mode by moving the TIME OF DAY switch to the down position.
- The DIASTOLIC display initially shows a numeric code that designates the revision level of the firmware installed in the unit, and then displays a number proportional to transducer noise.

  The numeric code is derived from the two-letter alphabetical revision level code found on the EPROM labels on the CPU board. A numeric weight is assigned to the letters of the alphabet, 0 to 25 for

5.1.1
Using Calibration Modes 1, 2, 3, and 4
Continued

A to Z; these weights then are applied according to the following formulae.

DIASTOLIC code = (weight of 1st letter) x 26 + (weight of 2nd letter)

REVISION LEVEL = INTEGER (DIASTOLIC code 26) = (weight of 1st letter)
DIASTOLIC code - (26 x [weight of 1st letter]) = (2nd letter weight)

For example, if the revision level of the firmware installed in the unit is AZ the DIASTOLIC display code would be
= (0) x 26 + (25)
= 025

Consequently, to derive the alphabetical revision level code from the numeric code
INTEGER (25/26) = 0 (1st letter. A)
25 - (26 X 0) = 25 (2nd letter. Z)

The noise level of the transducer can be monitored with no cuff attached and placing TIME OF DAY switch in the down position. The display should show a number between 0 and 2. A number greater then 2 indicate excessive noise. This mode applies to software revision R*H/R*H or greater for 1846 SX or 1846 SX/P, respectively.

Monitors with newer software revisions (RCH for SX, RDH for SX/P or higher) will only show numeric code for approximately 4 seconds before displaying a number proportional to FPT noise. To monitor this function properly, disconnect hose/cuff assembly from unit and place TIME OF DAY switch in the "down" position. This places the unit in the neonatal gain mode. The DIASTOLIC window should have a value between 0 and 2. A number higher than 2 indicates excessive noise.

The front panel should appear as shown in Figure 5-2.

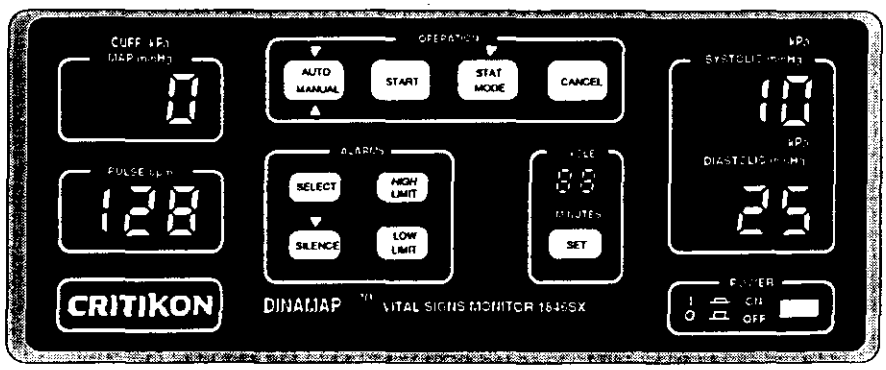

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Figure 5-2A Calibration Mode 2 Display

5.1.1
Using Calibration Modes 1, 2, 3, and 4
Continued

5.1.1.3 CALIBRATION MODE 3 Calibration Mode 3 is entered from Calibration Mode 2 by momentarily pressing the (CYCLE) SET switch. In Calibration Mode 3,

- ☐ the CUFF indicator remains lighted;
- ☐ the (CYCLE) SET display window continues to flash 88s;
- ☐ the digital input to the D/A converter is alternately switched between hex '00' and hex 'FF' every 10 seconds for calibration purposes and the numeric displays show the internal supply and battery voltages as follows:
- ☐ The MAP display shows the monitored +5 Vdc logic supply. This indication will normally read between 470 and 530, corresponding to a supply voltage of + 4.70 and + 5.30 Vdc. Any voltage outside this range will be flashed to indicate that the voltage is out of tolerance.
- ☐ The PULSE display shows the monitored battery voltage of the real-time clock. This indication normally will be between 288 and 380 corresponding to battery voltage of + 2.88 and + 3.80 Vdc. Any voltage outside this range will be flashed to indicate that the voltage is out of tolerance.
- ☐ The SYSTOLIC display shows the monitored + 12 Vdc analog supply. This indication will normally be between 113 and 127, corresponding to a supply voltage of + 11.3 to + 12.7 Vdc. Any voltage outside this range will be flashed to indicate that the voltage is out of tolerance.
- ☐ The DIASTOLIC display *alternately* (every five seconds) shows the monitored -12 Vdc analog supply and the monitored + 8 Vdc audio alarm/display/solenoid drive power supply. This indication normally will be between 113 and 127, corresponding to a supply voltage of -11.3 to -12.7 Vdc, and normally will switch between 733 and 866 representing the other supply voltage of + 7.33 and + 8.66 Vdc. Any voltages outside the ranges will be flashed to indicate that the voltage is out of tolerance.

Refer to Figure 5-3 for appearance of front panel.

5.1.1
Using Calibration Modes 1, 2, 3, and 4
Continued

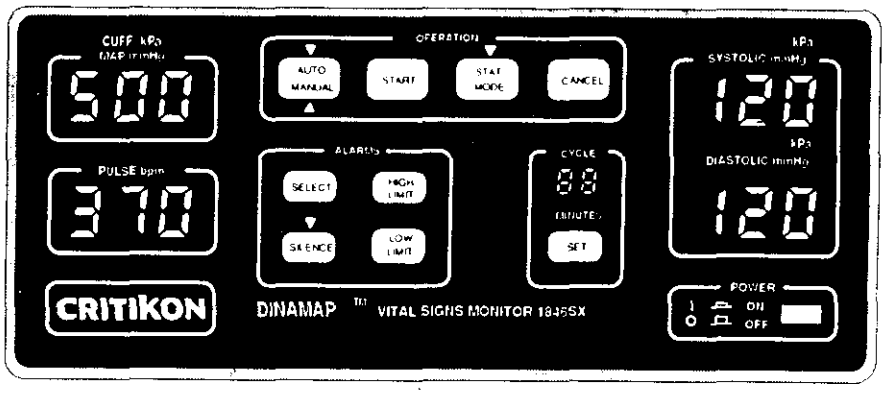

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Figure 5-3. Calibration Mode 3 Display

5.1.1.4 CALIBRATION MODE 4 Calibration Mode 4 exercises the front panel displays. This mode is entered from Calibration Mode 3 by momentarily pressing the (CYCLE) SET switch. In Calibration Mode 4,

- the CUFF indicator remains lighted;
- all 14 display windows briefly and simultaneously show 2s for three seconds followed by 4s, then 5s and then 7s. Verify that all digits show the number "2" and nothing else; in the same manner verify the subsequent numbers.

Next, all displays are blanked and a single "8" appears in the left-most LED digit display and 'walks' marquee-style left to right through the MAP display, then SYSTOLIC, PULSE, DIASTOLIC, and CYCLE MINUTES displays, spending 1/2 second at each position. Verify that all the number "8" is displayed, i.e., no missing segments, and that no other digit displayed is lit in any way, and that the order of display is correct. The sequence will repeat until the calibration mode ends. Each round takes eight seconds and continues until SET is pressed causing the rollover re-entry to Calibration Mode 1, or the calibration mode state is exited.

To exit calibration mode, press CANCEL, START, or STAT to return to manual operation.

If a printer is connected to a Monitor when the unit is placed in calibration mode, the unit shall cause the printer to print (once only) the data for calibrate mode as in Figure 5-4 (a). The Model 1846 SX/P prints (once only) the data for calibrate mode as in Figure 5-4 (b).

5.1.1 Using Calibration Modes 1, 2, 3, and 4 *Continued*

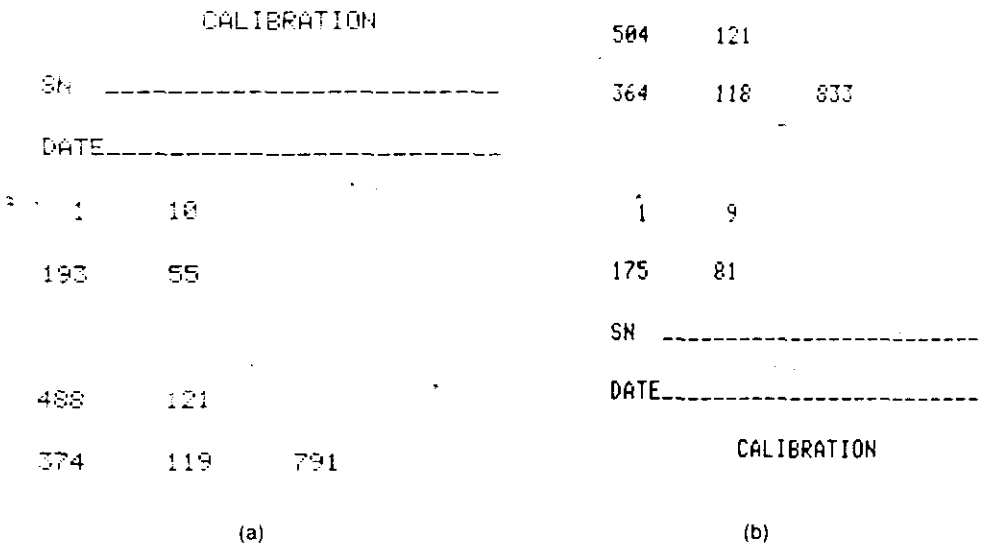

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Figure 5-4. Model 1846 SX (a) and Model 1846 SX/P (b) Calibration Printout

5.2 PERIODIC MAINTENANCE

Periodic maintenance tasks include cleaning the Monitor, checking pressure calibration, checking for pneumatic leaks, checking the overpressure cutout switch, check for noise on the filtered pressure transducer circuit, and checking the front panel display LEDs.

5.2.1 Cleaning the Monitor

The only maintenance routinely required is that the Monitor and accessories are kept clean and are handled and used according to the instructions provided here and in the Operation Manual (776-366)

The exterior of the Monitor may be wiped clean with a cloth slightly dampened with mild detergents or normal hospital bacteriocides.

- ☐ Do *not* immerse the Monitor.
- ☐ Do *not* clean with isopropyl alcohol or other solvents.
- ☐ The Adult Cuffs supplied for use with this Monitor may be cleaned by hand washing in warm soapy water. Care should be exercised, however, to insure that no water enters the cuff or cuff hoses at any time. Should water accidentally enter the cuff it may be dried by passing air through the cuff.
- ☐ The Neonatal Cuffs are supplied for single use and should be discarded if they become soiled.
- ☐ Do *not* immerse hoses.
- ☐ Do not immerse cuffs without prior application of cuff hose caps.

5.2.2 Performing a Calibration Display Check

Calibration of the Monitor should be checked at least every three months or when there is doubt about the validity of the pressure readings.

CAUTION

Calibration equipment should always be kept dry and free of particulate matter. Moisture or foreign substances introduced into the pneumatic system can cause damage to the unit.

To perform a calibration check, follow these procedural steps:

1. Obtain the calibration kit (Part Number 320-246) supplied with the unit.
2. Connect a manometer with sufficient range to the Monitor using the parts supplied with the calibration kit as shown in Figure 5-5.
3. Plug the Monitor into the specified line power outlet.
4. Clamp off the manometer between the "Y" adapter and the manometer. Fold the cuff in such a way so that the Index Line is in line with the Inner Range mark on the inside of the cuff.

5.2.2
Performing a Calibration Display Check
Continued

NOTE
In calibration procedure, use an adult cuff (Reorder No. 2774) and 12-foot hose (Reorder No. 8841).

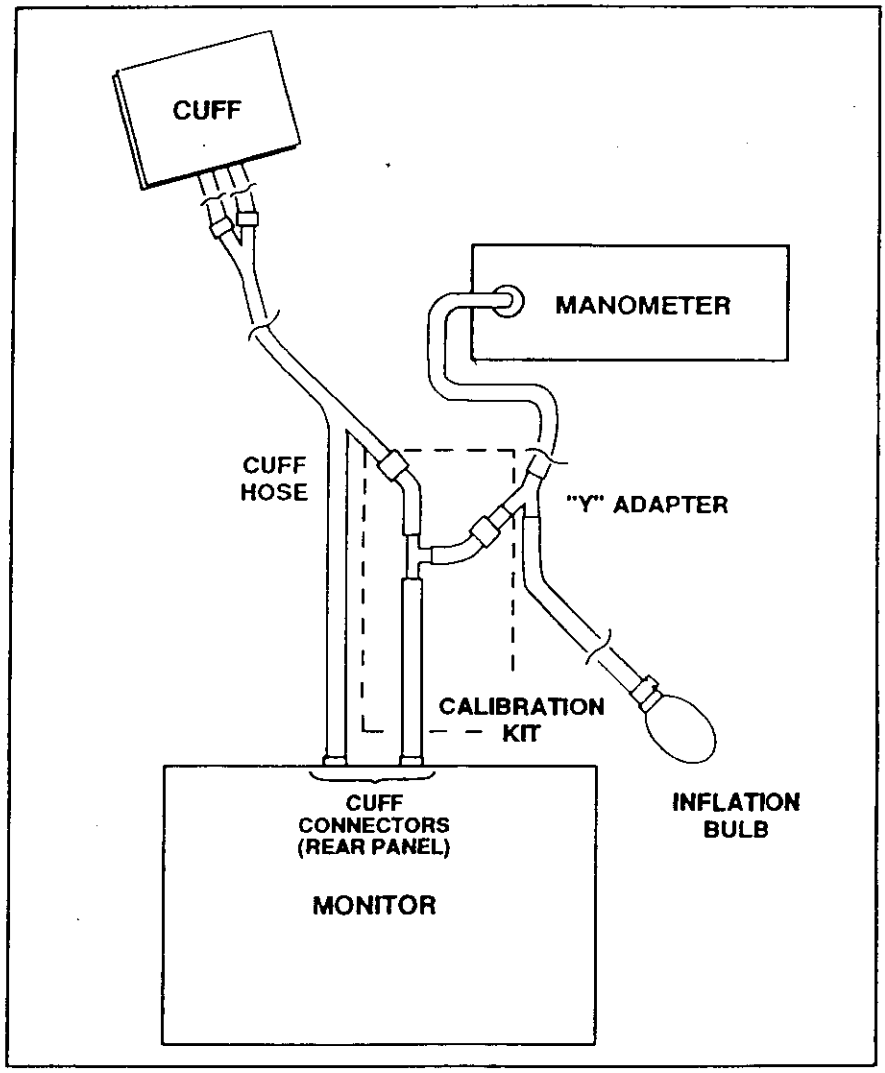

Figure 5-5. Calibration Check Setup

5.2.2 Performing a Calibration Display Check Continued

5. Press and hold the SET switch while pressing the POWER ON switch. The unit will turn on, the CUFF indicator lights, cuff pressure displays in the MAP window, and the 88s will flash in the CYCLE MINUTES window to confirm that the calibration mode is entered.

6. Press the SET switch three (3) times to enter Calibration Mode 4, the front panel display check. The CUFF indicator remains lighted and all 14 display digits, including CYCLE MINUTES, simultaneously should show 2s, then 4s, then 5s, then 7s, and the single 'walking' 8 (refer to Para 5.1.1.4 if necessary). Press the SET switch again to return to Calibrate Mode 1, or repeat step 5.

7. Close the pneumatic release valve on the inflation bulb and (avoiding pressure spikes) *slowly* pump up the manometer to the pressure values as indicated in the table below. Verify that the MAP display indicates the same pressure as the manometer reading, ± 3 mmHg.

APPLIED PRESSURE, MANOMETER	MONITOR MAP DISPLAY
200 mmHg ± 2 mmHg	Manometer Reading ± 3mmHg
150 mmHg ± 2 mmHg	Manometer Reading ± 3mmHg
100 mmHg ± 2 mmHg	Manometer Reading ± 3mmHg
50 mmHg ± 2 mmHg	Manometer Reading ± 3mmHg

8. Remove clamp from manometer tubing.

9. If the indicated pressures are not within tolerance, perform the Pressure Calibration Adjustments (see Para. 5.3.2).

5.2.3 Performing A Pneumatic Leak Check

To perform a check for a pneumatic leak, follow these procedures.

1. Obtain the calibration kit (Part Number 320-246) supplied with the Monitor.

NOTE

For pneumatic leak check only, use Adult Cuff (Re-order 2774) and 12 ft. Air Hose (Re-order 8841).

2. Connect a manometer with sufficient range to the Monitor using the parts supplied with the calibration kit as shown in Figure 5-5.

3. Plug the Monitor into the specified power outlet

Performing A Pneumatic Leak Check
Continued

4. Press and hold the SET switch while depressing the POWER ON switch. Flashing 88s in the CYCLE MINUTES display confirm that calibration mode has been entered. The unit will turn on, will light the CUFF indicator, and display cuff pressure in the MAP display.

5. Clamp off the manometer tube.

6. Using an inflation bulb, slowly pump up (avoiding pressure spikes) to a pressure of 200 mmHg ± 2 mmHg as indicated on the MAP display.

7. Verify that the pressure displayed in the MAP display does not change more than 5 mmHg in 60 seconds for all cuff and hose combinations

NOTE

If the leakdown is greater than 5 mmHg in 60 seconds, check cuff and hose junctions and rubber "O" rings for cracks, tears, or breaks. If no cuff or hose leaks are found, the problem is probably located in the internal pneumatics section.

Check for pneumatic leaks in the cuff, connection hose and fittings and finally the pneumatics module.

It is important to note that because of the advanced cuff inflating pneumatics of the Model 1846 SX series, it is possible for the pressure to actually increase during this check. This will occur only if the pneumatics module Inflate Valve (V3) becomes faulty. If a leak is found in the pneumatics module and cannot be fixed, replace the pneumatics module.

8. The seal on the SX pneumatics module reservoir represents another potential source of air leakage. Although not as serious as a leak on the blood pressure cuff side of the system, the disadvantages include loss of rapid cuff inflation, extra wear on the internal air pump, and possible increased annoyance at the too frequent sound of the air pump restoring the constant pressure loss. In general the unit, once initially "pumped up" and left alone in the idle mode, should not need to restore reservoir pressure in less than 15 minutes after the end of the previous pump-up cycle.

5.2.4 Cuff and Hose Leak Check

1. Obtain the calibration kit (Reorder No. 8886) supplied with the unit.

2. Connect a manometer (Druck DPI203, or equivalent) with the parts supplied in the blood pressure calibration kit as shown in Figure 5.6.

3. Close the pressure release valve on the manometer inflation bulb and slowly pump up the pressure to 200 mmHg ± 2 mmHg, as indicated by the manometer.

5.2.4 Cuff and Hose Leak Check Continued

4. Verify that the manometer pressure does not fall by more than 5 mmHg in 60 seconds. If it does, either the cuff or hose or both are defective. If the cuff and the hose pass this test reconnect as shown in Figure 5-5. Pump up the cuff and hose to 200 mmHg, ± 2 mmHg, and perform the same leak check to determine if the leak is, in fact in the monitor. Perform this leak check for all cuff and hose combinations used with the monitor.

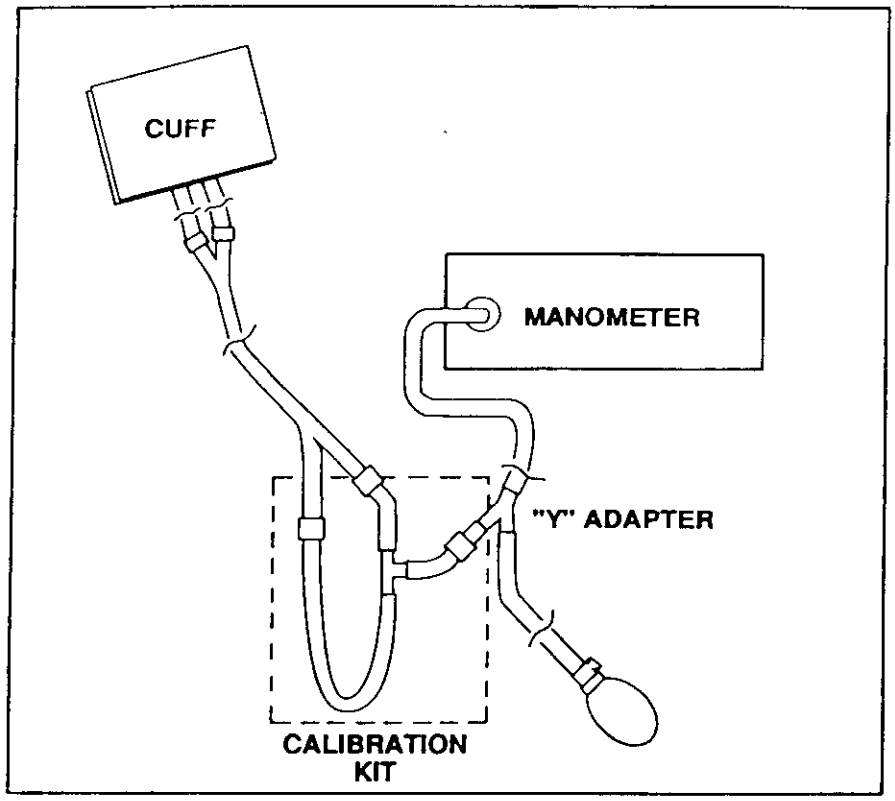

Figure 5-6. Cuff and Hose Leak Check Setup

5.2.5 Performing An Overpressure Cutout Check

To perform a check for an overpressure cutout, follow these procedures.

1. Obtain the calibration kit (Part Number 320-246) supplied with the Monitor.

2. Connect a manometer with sufficient range to the Monitor using the parts supplied with the calibration kit as shown in Figure 5-5.

3. Plug the Monitor into the specified line power outlet.

5.2.5 Performing An Overpressure Cutout Check Continued

4. Press and hold the SET switch while depressing the POWER ON switch. The Monitor will turn on, will light the CUFF indicator, and will display cuff pressure in the MAP display. Flashing 88s in the CYCLE MINUTES display confirms calibration mode has been entered.

5. Using an inflation bulb, slowly (10 ± 5 mmHg/sec) pump up the manometer (avoiding pressure spikes) to a pressure of 350 mmHg ± 45 mmHg and verify that the Monitor opens the Dump and Step Deflate Valves, and issues an 800 system level alarm. If a cuff pressure in the range of 305 mmHg to 395 mmHg does not cause the Monitor to issue an 800 system level alarm, refer to the overpressure switch adjustment procedure in Para. 5.3.3.

5.2.6 Performing A Reservoir Pressure Level Check

The static reservoir stored pressure cannot be measured without removal of the Monitor chassis cover (not recommended for routine checks) because of the cuff overpressure protection feature. If a problem appears likely, such as excessively long cuff inflation times, refer to Para 5.3.4, Reservoir Pressure Control Switch Check and Adjustment.

5.3 ALIGNMENT AND ADJUSTMENTS

Before attempting any alignment or adjustment procedures, the equipment listed in Table 5-1 must be made available for use.

TABLE 5-1. ALIGNMENT AND ADJUSTMENT EQUIPMENT LIST

EQUIPMENT	MANUFACTURER	MODEL
Digital Voltmeter	Fluke	8020 (or equivalent)
Calibration Kit	Critikon, Inc.	320-246
Manometer	Druck DPI203 (or equivalent)	
Variable DC Power Supply	Power Designs	6010 (or equivalent)

The adjustment procedures for the following items are described in subsequent paragraphs:

- ☐ pressure calibration of the 1846 SX and 1846 SX/P CPU board;
- ☐ power-up reset circuit for the 1846 SX and 1846 SX/P CPU board;
- ☐ overpressure switch threshold in the 1846 SX and 1846 SX/P pneumatics module;
- ☐ reservoir pressure control switch setting for the 1846 SX and 1846 SX/P pneumatics module;

5.3 ALIGNMENT AND ADJUSTMENTS

- ☐ printer contrast for the 1846 SX/P; and
- ☐ baud rate for the 1846 SX/P.

For any of these procedures refer to Figure 6-1 (Model 1846 SX) or Figure 6-2 (Model 1846 SX/P) and remove the four cover hold-down screws (item 21). Remove the cover (item 5) and locate the item specified.

5.3.1 CPU Power-On Reset Threshold Adjustment

The CPU board is equipped with 30 test points and five potentiometer adjustments that are located on the board. See Figure 5-6. The test point measurements are defined and the voltage levels are specified for the various operating conditions in Table 5-2.

The CPU power-on reset threshold is adjusted by R80. This adjustment is set at the factory to enable the CPU RESET signal when the + 5 Vdc power supply falls below a threshold of 4.75 Vdc. +0.02 - 0.00 Vdc. To verify this setting and to make the adjustment, perform the following procedure:

1. Turn Monitor power off.
2. Remove the CAL jumper header from the staked pins on the CPU board. Refer to Figure 5-7 for location. Observe that one pin is marked "+" and one pin is marked "CAL".
3. Connect the variable + 5 Vdc source leads to the CPU board positive lead to the CAL pin, negative lead to Test Point #28.
4. Adjust the variable + 5 Vdc source for an output voltage of + 4.75 to +4.77 Vdc and then *turn the power supply off.*

CAUTION
DO NOT ALLOW THE VOLTAGE AT THE CAL PIN TO EXCEED + 5.5 Vdc.

5. Connect a jumper between U13-1 and TP28.
6. Turn on power to the Monitor and then turn the test power supply on and check for a Power-Up System Alarm. If the alarm occurs, jump to step 8. If the alarm does not occur, go to step 7.
7. Turn the adjusting screw on R80 slowly clockwise until the Monitor issues a Power-Up System Alarm. If adjusting R80 fully clockwise does not produce a Power-Up System Alarm, repair the CPU board or replace it.
8. Turn the adjusting screw on R80 *slowly* counterclockwise until the Monitor front panel goes blank.

5.3.1
CPU Power-On Reset Threshold Adjustment
Continued

9. Carefully raise the supply voltage until a Power-Up System Alarm is obtained. Slowly lower the voltage until the Monitor front panel goes blank. Verify the supply voltage is then 4.75 Vdc to 4.77 Vdc.

10. Turn off Monitor power and remove the variable + 5 Vdc power supply and replace the CAL jumper/header.

11. Remove the jumper between U13-1 and TP28.

12. Turn on Monitor power and verify that the Monitor performs a Power-Up System Alarm.

13 Remove the CAL jumper header and verify that the Monitor issues the Microprocessor Failure System Alarm.

14. Replace the CAL jumper/header.

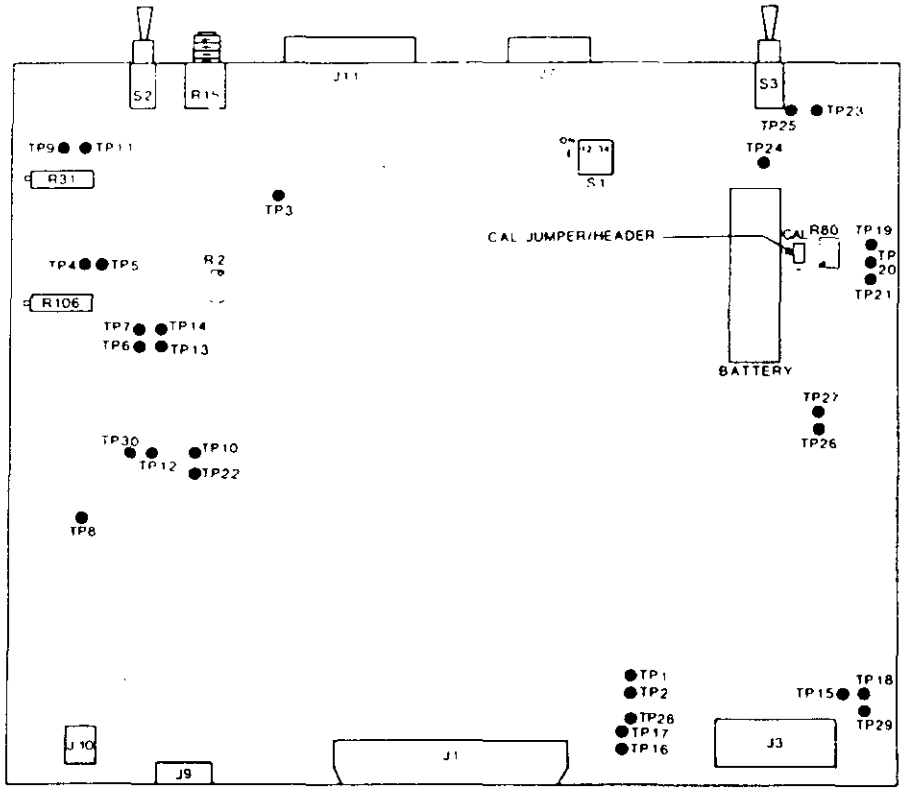

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Figure 5-7. CPU Board Test Points and Adjustments

5.3.1
CPU Power-On Reset Threshold Adjustment
Continued

TABLE 5-2. CPU BOARD TEST POINT MEASUREMENTS

TEST PT. (REF.)	SIGNAL NAME	READING	CONDITION
TP1 (TP28)	OVERPRESSURE SWITCH (OVP-1)	+ 5 Vdc	350 mmHg ± 45 mmHg causes OVP-1 to go true to interrupt the CPU
TP2 (TP28)	CPU HOLD-1	0 Vdc	TP2 is tied to ground through R1. Applying + 5 Vdc to TP2 will HOLD the CPU for test purposes
TP3 (TP5)	D/A ANALOG CHANNEL 5 (PR)	0-2.55 Vdc	Analog PULSE signal varies from 0 to 2.55 Vdc corresponding to a pulse rate of 0 to 255 BPM
TP4 (TP5)	FILTER CHECK SIGNAL INPUT	—	TP4 is used at the factory to check the bandpass for the *Filtered Pressure* Transducer and is not used for troubleshooting
TP5	Analog Ground	—	TP5 is preferred over other analog groundpoints when making most sensitive measurements in the analog pressure channels
TP6 (TP5)	PRESSURE TRANSDUCER CLAMPED OUTPUT	-0.3 to + 5.3 Vdc	This is the clamped pressure signal into the A/D. This voltage varies linearly from 0 to 5.0 Vdc corresponding to pressures from 0 to 255 mmHg. Pressures above 255 mmHg are clamped at 5.0 Vdc.

5.3.1
CPU Power-On Reset Threshold Adjustment
Continued

TABLE 5-2. CPU BOARD TEST POINT MEASUREMENTS — Continued

TEST PT. (REF.)	SIGNAL NAME	READING	CONDITION
TP7 (TP5)	PRESSURE TRANSDUCER OUTPUT	0-6.0 Vdc	This is the unclamped Pressure Transducer signal. This voltage varies linearly from 0 to 6.0 Vdc corresponding to pressures from 0 to 300 mmHg
TP8 (TP5)	AUTO ZERO OFFSET	-1.7 to + 1.7 Vdc	An Auto Zero is performed at the beginning of every determination or when entering Calibration Mode 1
TP9 (TP5)	ANALOG REFERENCE	+5.0 Vdc ± 0.01 Vdc	At all times during power on .
TP10 (TP5)	FILTERED PRESSURE TRANSDUCER OFFSET VOLTAGE	+0.2 Vdc	At all times during power on
TP11 (TP18)	ANALOG REFERENCE VOLTAGE	+10.0 Vdc ± 0.2 Vdc	At all times during power on.
TP12 (TP5)	UNCLAMPED TRANSDUCER OUTPUT	-0.3 Vdc to + 10.0 Vdc	This signal varies with the pressure oscillations in the cuff during a determination
TP13 (TP5)	CLAMPED FILTERED TRANSDUCER OUTPU	-0.3 to + 5.3 Vdc	This signal varies with the pressure oscillations in the cuff during a determination and is clamped to +5 Vdc for input to the A/D converter
TP14 (TP5)	RAW PRESSURE TRANSDUCER OUTPUT	-10.0 to + 5.0 Vdc	This is the uncorrected pressure transducers signal
TP15 (TP28)	+5 VOLT DC LOGIC SUPPLY	+5 Vdc ± 0.2 Vdc	At all times during power on.

5.3.1
CPU Power-On Reset Threshold Adjustment
Continued

TABLE 5-2. CPU BOARD TEST POINT MEASUREMENTS — Continued

TEST PT. (REF.)	SIGNAL NAME	READING	CONDITION
TP16 (TP17)	+8 VOLT DC DRIVER SUPPLY	+8 Vdc ± 0.3 Vdc	At all times during power on .
TP17	+8 VOLT DC RETURN	—	—
TP18	ANALOG GROUND	—	—
TP19 (TP28)	POWER UP FS RESET THRESHOLD	0-2.625 Vdc	Greater than +1.22 Vdc drops CPU RESET
TP20 (TP28)	RESET REFERENCE VOLTAGE	+1.22 Vdc	At all times during power on
TP21 (TP28)	POWER UP RESET TIMER CLOCK	0-0.5 Vdc	122 Hz reset pulse train
TP22 (TP28)	SERIAL CLOCK DATA OUT	0-5.0 Vdc	Serial pulse train when clock is read
TP23 (TP24)	CLOCK BATTERY DRAIN	0.065 Vdc Max.	During power off max.
TP24 (TP28)	CLOCK BATTERY VOLTAGE	2.88-3.89 Vdc	At all times Vdc
TP25 (TP24)	A/D DRAIN ON CLOCK BATTERY	2.88-3.80 Vdc	During power off
TP26 (TP18)	+ 12 VDC ANALOG SUPPLY	+ 12 Vdc ± 0.25 Vdc	At all times during power on.
TP27 (TP18)	- 12 VDC ANALOG SUPPLY	- 12 Vdc ± 0.50 Vdc	At all times during power on.
TP28	DIGITAL GROUND	—	—
TP29 (TP17)	+14 VDC UNREGULATED	+ 11.00 to + 18.00 Vdc	At all times during power on .
TP30 (TP28)	ADULT-0 NEONATE-1	0-5.0 Vdc	0 = adult cuff 5.0 = neonate cuff

5.3.2
Pressure Calibration Adjustments

Should a 822 System Alarm occur or the unit fail the calibration check as described in Para. 5.2.2, the following adjustment procedure should be performed. If any adjustment fails to effect the indicated result, the CPU board should be repaired or replaced.

Since the adjustments are interactive, the following procedural steps must be adhered to:

5.3.2 Pressure Calibration Adjustments Continued

1. Place the Monitor in Calibration Mode 3.
2. REFERENCE VOLTAGE ADJUSTMENT (R31): Connect the positive lead of the DVM to TP9; negative lead to TP5. Adjust R31 for an indication of + 5.00 Vdc. ± 0.01 Vdc. Connect the positive lead of the DVM to TP11 and verify that the indication is + 10.0 Vdc. ± 0.2 Vdc. If these levels cannot be attained, repair the Reference Voltage regulator circuit or replace the CPU board.
3. D/A FULL SCALE OUTPUT ADJUSTMENT (R2): Connect the positive lead of the DVM TP3. Verify that the voltage indication alternates between some positive voltage and zero, spending approximately 10 seconds at each level. Adjust R2 to produce + 2.550 Vdc. ± 0.005 Vdc, at the high level period. Verify that the low level period indicates 0.000 Vdc. ±0.011 Vdc. If these levels cannot be attained, repair the D/A circuit or replace the CPU board.
4. Set up the unit for a calibration check as shown in Figure 5-5.
5. Place the Monitor in Calibration Mode 1.
6. Manually pump up the pressure to a reading of 150 mmHg ± 1 mmHg as indicated on the manometer.
7. PRESSURE TRANSDUCER FULL SCALE OUTPUT ADJUSTMENT (R106): Adjust R106 for a reading in the MAP display of 150 mmHg ± 1 mmHg.
8. Press the CYCLE SET switch four times to step through the calibration modes and re-enter Calibration Mode 1. A new Auto Zero correction will be obtained upon entering Calibration Mode 1. Repeat steps 6 through 8 until the correct manometer pressure is always displayed in Calibration Mode 1 after the Auto Zero step is performed.
9. Turn the Monitor off and then perform the Calibration Check as specified in Para. 5.2.2.

5.3.3 Overpressure Switch Adjustment

The overpressure switch in the pneumatics module is set at the factory to trigger an 800 system level alarm whenever cuff pressure reaches 350 mmHg ± 45 mmHg. If it is determined during the Overpressure Cutout Check (Para. 5.2.4) that the overpressure switch is not functioning properly, perform the following adjustment procedure:

1. Obtain the calibration kit (Part Number 320-246) supplied with the unit.
2. Connect a manometer with sufficient range or a digital pressure gauge to the Monitor using the parts supplied with the calibration kit as shown in Figure 5-5.

5.3.3 Overpressure Switch Adjustment Continued

3. Plug the Monitor into the specified line power outlet.

4. Press and hold the SET switch for 20 seconds while pressing the POWER ON switch. The unit will turn on, light the CUFF indicator, display cuff pressure in the MAP display, and flash 88 in the CYCLE MINUTES display to confirm you have entered the calibration mode. If you don't hold the SET switch for at least 20 seconds, the Monitor will exit the calibration mode after 3 minutes.

5. Refer to Figure 6-1 (Model 1846 SX) or Figure 6-2 (Model 1846 SX/P) and remove the four cover hold-down screws (item 21). Remove the cover (item 5) and locate the pneumatics module (item2).

6. Refer to Figure 6-5 and locate the overpressure switch (item 11).

NOTE

Do not confuse the overpressure switch (item 11) with the air reservoir pressure control switch (item 12) and vice-versa. Their appearance is almost identical.

Locate the recessed hexagonal set screw in the top of the overpressure switch. Using a 0.050 inch Allen wrench, the set screw may be adjusted to change the pressure at which the overpressure switch trips. Turning the screw clockwise increases the pressure at which the switch trips while turning the screw counterclockwise decreases the pressure at which the switch trips.

7. Using an inflation bulb, slowly pump up the manometer (avoiding pressure spikes) to a pressure of 350 mmHg ± 45 mmHg and adjust the set screw on the overpressure switch to trip the switch in this range. If an 800 system level alarm is generated before the switch can be adjusted to this range, you must turn power OFF and repeat step 4. If the 800 system level alarm is not generated regardless of the switch setting and the pressure applied, refer to Troubleshooting, Para. 5.4.11.

5.3.4 Reservoir Pressure Control Switch Check and Adjustment

The reservoir pressure control switch in the pneumatics module is factory set to maintain 460 ± 10 mmHg (about 9 PSIG) above ambient air pressure while a cuff is not being inflated. When the reservoir pressure falls below approximately 8 PSIG as a result of discharge (cuff inflation) or nominal system leakage, the pump motor is actuated. The exact pressure at which the pump starts is not critical within reason and is a function of the switches inherent mechanical hysteresis, an unspecified quantity.

Since an air reservoir pressure control switch check requires the same level of Monitor disassembly as does the actual adjustment of either pneumatics module pressure switch (control or pressure), this check is

5.3.4
Reservoir Pressure Control Switch Check and Adjustment
Continued

not part of the routine calibration check. The reservoir pressure control switch check is performed only when convenient, i.e., in conjunction with other needed service work, or if indicated by any of the following symptoms when the Monitor is powered on or in use:

1. If a properly applied adult cuff is not fully inflated in 3-5 seconds to the initial default target pressure (approximately 170 mmHg) on the first determination after the unit is powered on. (Wait until the pump has stopped, indicating a full reservoir, before initiating the determination; and do not include the time required for cuff typing.)

2. If the pump takes longer than 20 seconds or shorter than 10 seconds to repressurize an essentially empty reservoir. The reservoir can be dumped by starting a determination with the cuff/hose assembly not attached to the cuff inflation port connector. Wait 10 seconds, then cancel the determination to close the Inflate Valve, and begin timing the reservoir inflation.

3. If the unit consistently generates 800 system level (overpressure) alarms and the other likely causes of overpressure have been eliminated.

To check and adjust the reservoir pressure control switch setting, perform the following procedure:

1. Connect the Monitor calibration kit and a medium-range pressure gauge (0-10 PSIG) as shown in Figure 5-8. Do not attach a cuff hose to the connector, but instead gently clamp off the tubing with surgical hemostats or similar.

CAUTION

Be sure the pressure gauge or manometer has the required range (0-10 PSIG or 0 mmHg-500 mmHg reading) and will not be damaged by pressure up to 25 PSIG.

5.3.4 Reservoir Pressure Control Switch Check and Adjustment Continued

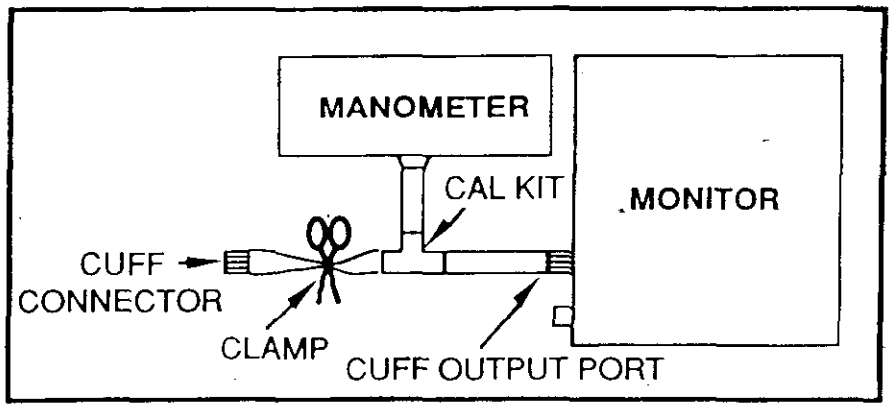

Figure 5-8. Air Reservoir Pressure Control Switch Adjustment

2. Refer to figure 6-1 (for Model 1846 SX) or figure 6-2 (for Model 1846 SX/P) and remove the four cover hold-down screws (item 21). Remove the cover (item 5) and locate the pneumatics module (item 2).

3. Refer to Figure 6-5 and locate the overpressure switch (item 11). Clamp off the tubing leading to the overpressure switch. If using metal hemostats, be sure not to short the CPU logic PWA circuitry.

4. Plug the Monitor into the specified line power outlet. Press the POWER ON switch and allow the reservoir to inflate completely.

5. Press the START switch to open the Inflate Valve and measure the reservoir peak pressure. This should be 460 mmHg (8.7 - 9.1 PSIG).

6. Slightly unclamp the tubing at the cal kit and allow the reservoir pressure to bleed off *only as fast as the pressure gauge can be accurately read.* The pump should turn on when the pressure falls between 336-439 mmHg (6.5-8.5 PSIG).

7. Adjust the air reservoir pressure control switch (item 12) if necessary (clockwise to increase pressure, counterclockwise to decrease pressure), rechecking the reservoir pressure set points after each adjustment to the control switch.

5.3.5 Model 1846 SX/P Printer Contrast Adjustment

The printer contrast adjustment is made by adjusting a potentiometer (R20) on the Model 1846 SX/P printer PWA. To make this adjustment, perform the following procedure:

5.3.5
Model 1846 SX/P Printer Contrast Adjustment
Continued

1. Unscrew the knurled hold-down screw on the rear panel of the printer module until the printer module springs forward, then slide the printer chassis out to the front until it stops.
2. Remover the spare paper roll from the spring clip at the rear of the printer chassis.
3. Slide the paper roll in use off the spindle and cut at least six inches of paper off the roll and leave it feeding into the printer slot.
4. Refer to Figure 6-10 and remove the four screws (item 8) holding down the paper magazine floorplate (item 2) and remove the floorplate.
5. Refer to Figure 6-10 and defeat the safety interlock switch (item 23) on the rear of the printer chassis.
6. Place the rocker-type POWER ON/OFF switch on the front of the printer module to the ON position.
7. Refer to Figure 6-11 and locate R20, the contrast oscillator adjusting potentiometer.
8. Turn the adjusting screw clockwise to darken the print, counterclockwise to lighten the print.
9. Check the contrast by pushing the POWER ON/OFF button on the front of the Monitor and read the heading printed on the paper remaining in the slot.

5.3.6
1846 SX/P Baud Rate Adjustment

The baud rate adjustment is made by adjusting a potentiometer (R5) on the 1846 SX/P printer PWA. To made this adjustment, perform the following procedure:

1. Unscrew the knurled hold-down screw on the rear panel of the printer module until the printer module springs forward, then slide the printer chassis out to the front until it stops.
2. Remove the spare paper roll from the spring clip at the rear of the printer chassis.
3. Slide the paper roll in use off the spindle and cut at least six inches of paper off the roll and leave it feeding into the printer slot.
4. Refer to Figure 6-10 and remove the four screws (item 8) holding down the paper magazine floorplate (item 2) and remove the floorplate.
5. Refer to Figure 6-10 and defeat the safety interlock switch (item 23) on the rear of the printer chassis.

5.3.6
1846 SX/P Baud Rate Adjustment
Continued

6. Place the rocker-type POWER ON/OFF switch on the front of the printer module to the ON position.
7. Refer to Figure 6-11 and locate R5, the baud rate adjusting potentiometer.
8. Connect the frequency counter to TP1 with respect to TP5.
9. Turn the frequency counter ON.
10. Push the latching POWER ON/OFF pushbutton on the front of the Monitor.
11. Adjust R5 on the printer module PWA for a reading of 9600 Hz, ± 100 Hz. Turning the adjusting screw clockwise decreases the frequency, counterclockwise increases the frequency.

5.4 TROUBLESHOOTING

In troubleshooting, refer to the system Functional Block Diagram, Figure 4-1. Keep in mind that you always have the option to replace the entire module when a faulty component is believed to be the source of a problem.

5.4.1
899 Determination Unsuccessful Alarm

The 899 alarm results when the Monitor cannot detect sufficient pressure pulsations and the cuff becomes deflated to 7 mmHg. Vital signs of low magnitude, e.g., patients experiencing shock, ventricular fibrillation or pulse rate less than 40 BPM might be the cause.

System hardware failures that could generate 899 include:

- ☐ Any fault in the analog Pressure Pulsation Filter Amplifier circuitry beginning at the Full Scale Gain potentiometer R106 up to and including the D/A Converter/MUX itself. Observe, however, that most failures in this circuit would cause alarm code 822 (Needs Calibration or Service) because the automatic bandpass filter self-test should be failed.
- ☐ A partially occluded pneumatic hose on the pressure transducer side of the system. Check for kinks in the cuff connector hose or pneumatic module tubing particularly in the hose from the Auto Zero Valve to the CPU board pressure transducer.

5.4.2
888 Power-On Alarm

This alarm occurs when the + 5 Vdc power supply to the CPU board crosses from below to above a threshold of about 4.8 volts, and signifies that the microprocessor system is running its program from the beginning. Other than after intentionally turning the Monitor from Off to On, the 888 alarm is caused by:

5.4.2
888 Power-On Alarm
Continued

- ☐ Subsequent interruption, droop, or glitch in the AC line power. Verify the AC line power cord is good and is fastened properly to the rear panel receptacle.
- ☐ A power supply module defect.
- ☐ Intermittent connections in cable harness wiring or at plug socket contacts.
- ☐ Improper adjustment or failure of the Power-On Reset circuitry or connection to the microprocessor RESET-0 pin.

5.4.3
877 ROM Failure Alarm

This alarm indicates failure or change in a permanent program memory storage location. A check calculation is performed shortly after power-up and every few seconds thereafter whenever the Monitor is in 'wait state' (not attempting a determination or performing Printer Data Interface I/O).

The system is not guaranteed to display 877 since an altered program memory bit is likely to change the actual microprocessor programs currently being executed, yielding unpredictable and usually chaotic results. If the program becomes so changed, the hardware System Failsafe backup circuits are designed to place the Monitor in a safe and fully inoperative state.

If 877 happens at power-up, turn the Monitor Off for 10 seconds then On again. If this alarm code then reappears or occurs subsequently during Monitor operation, replace ROM U3.

5.4.4
866 RAM Failure Alarm

An 866 alarm indicates the static random access memory byte has failed to return the value expected to be stored there. A comprehensive bit-shifting read/write test is performed at power-up on all RAM U8 locations. Then, during subsequent 'wait states', a simpler byte-oriented test is conducted on addresses outside of the microprocessor stack space. The 256-byte RAM page in each I/O Port U5 and U6 is not used.

If 866 happens at power-up, turn the Monitor Off for 10 seconds then On again. If this alarm code then reappears or occurs subsequently during Monitor operation, replace RAM U8.

5.4.5
855 Excess Time: One Pressure Level Alarm

An 855 alarm occurs if, during a determination, the time between two (2) successive deflation steps exceeds 60 seconds. The following might cause the alarm:

- ☐ Kinked, crushed, or blocked cuff or cuff connector hose (most common cause), or internal hose.